New Millennium Program

New Millennium Program (NMP)

Guidelines for Preparation of NMP Technology Validation Plans and Technology Validation Reports

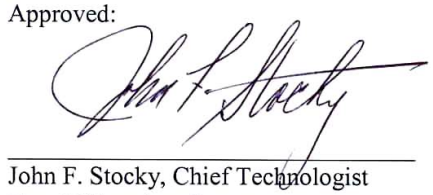
May 9, 2003

Version 1

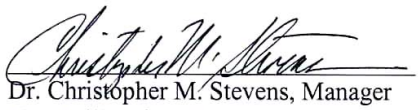
New Millennium Program

Guidelines for Preparation of NMP Technology Validation Plans and Technology Validation Reports, Version 1

Approved:



John F. Stocky, Chief Technologist
New Millennium Program



Dr. Christopher M. Stevens, Manager
New Millennium Program

Guidelines for Preparation of NMP Technology Validation Plans and Technology Validation Reports, Version 1

1.0 Purpose:

This document provides guidance for preparation of technology validation plans and technology validation reports for New Millennium Program (NMP) technology validation missions. Information provided in these guidelines is intended to assist technology providers in planning the preparation, update and release of these documents at appropriate milestones during the lifetime of the validation effort.

2.0 Background Information:

The overall goal of NMP is to validate the performance of breakthrough technologies in space that will enable new capabilities needed for future NASA Earth and space science missions and in so doing, reduce the risk to the first users of these technologies. Additionally, breakthrough technologies are selected for validation when their use will provide current capabilities at significantly reduced cost. In the NMP context, technology validation provides empirical evidence that the physics of the technology advance in question are understood. In many cases, analytical models and simulations are used to predict the performance of these technologies on the ground as well as in space. The technology performance data obtained on a NMP flight project is unique to the space environment and can be neither duplicated by ground testing nor simulated with confidence on the ground. Flight validation may be used to refine algorithms and to determine accurate values of parameters used in the models and simulations. Validated analytical models of the technology advance permit the envelope of applicability to extend to future applications that are not identical to the flight experiment or to the current version of the technology. In all cases, the new technology and the performance advantage it offers relative to the current state-of-the-art (SOA) must be clearly described. The technology validation plan applies only to the technology advance and is neither a product development plan nor an end-item qualification plan.

2.1 **The Technology Validation Plan** is the key document that guides validation activities on NMP flight projects and is appended to the project plan for each NMP flight project. A draft technology validation plan is required for the project System Requirements Review (SRR); appropriate updates are required for the subsequent project Preliminary Design Review (PDR) and Confirmation Review (CR). The final version of the technology validation plan is required for the project Critical Design Review (CDR). A detailed outline along with explanations of what information is required in each section of this plan is given in Section 3 of these guidelines.

2.2 **The Technology Validation Report** is a required deliverable at the conclusion of a NMP technology validation mission. Technology providers are required to prepare a technology validation report, present the validation results, and discuss potential future applications at a technology validation symposium for the benefit of potential future users of the technology. These reports will be distributed as the proceedings of the symposium. The outline of the technology validation report is the same as that of the technology validation plan except for the differences described later in Paragraph 5 of these guidelines. The Technology Validation Plan provides a description of what will be done to validate the technology under consideration. The Technology Validation Report is a detailed description of how the technology was validated and provides test data along with appropriate analyses as evidence of a successful technology validation effort. The Technology Validation Report is prepared in three steps with deliverables at key points during the project life cycle. The deliverable for the first step will contain the Cover Page, Table of Contents, Section 1, Section 2, and Section 3 (up through Section 3.1 with a description of appropriate ground test verification results) and will be delivered to NMP prior to the Critical Design Review during the Implementation phase of the project. The deliverable for the second step (containing those items required for the second step plus appropriate updates to Section 3.1 to show successful achievement of TRL 6) is prepared and delivered to NMP following integration and test of the flight system (System Test). The deliverable for the final step (containing those items required for Step 3 plus the Executive Summary, Acknowledgments, Sections 3.2, 4, and 5 as well as references and appendices) of the report is prepared and delivered to NMP no more than 90 days following the completion of the in-space validation of that technology. The schedule of deliverables for both the technology validation plan and the technology validation report is shown in Figure 1 of these guidelines.

3.0 Additional guidelines for preparation of Technology Validation Reports

3.1 Report Approval/Clearance

The author of each technology validation report is responsible for obtaining the appropriate approvals and clearances through his/her organization. For those reports with several authors, each author is responsible for obtaining the appropriate approvals and clearances for his or her section of the report. Authors(s) must submit a copy of the completed clearance/approval forms to both the Project Office and the New Millennium Program Office before the technology validation reports can be published and distributed. Even if the information in these reports has already appeared in previous publications in the open literature, these technology validation reports require (for public release) the approvals and clearances by the organizations preparing the reports and of any government agencies sponsoring the development of the technology. Approval for public clearance must take into account compliance with International Traffic in Arms Regulations (ITAR) and Export Administration Regulations (EAR).

3.2 Report Format

A uniform organizational outline, as shown in Section 3 of these guidelines, is required for all technology validation reports. The length of the report (maximum desired length is approximately 30 pages) must be negotiated with the NMP project office. The cover

page, table of contents, executive summary and optional appendices are not included in this page count. The report format must conform with the Institute of Electrical and Electronics Engineers (IEEE) standards for publication in peer-reviewed journals and conference proceedings. These standards are available at the following url:
http://www.ieee.org/organizations/pubs/transactions/information.htm

4.0 References
Detailed definitions of technology readiness levels (TRLs) used by NMP are found at the following url:
http://nmp.jpl.nasa.gov/program/program-documents.html

5.0 Outlines for Technology Validation Plan and Technology Validation Report

Section	Technology Validation Plan	Technology Validation Report	Section Content
Cover Page	Req'd	Req'd	The cover page should indicate the name of the technology being validated; and the authors(s) name, affiliation, phone number and e-mail address. Authors may add organizational logos and a graphic illustration of the technology.
Table of Contents	Req'd	Req'd	
Executive Summary	N/A	Req'd	The executive summary should provide a brief description of the technology validated on the flight project, the risks associated with the technology, validation objectives and approach, the test program, a brief summary of test results, and a brief summary of technology applicability and potential benefit to future NASA science missions. This summary should be no more than three pages in length.
Acknowledgments	N/A	Req'd	Since many individuals and organizations may have been involved in these technology validation efforts, the author(s) are encouraged to acknowledge these efforts in this section of the technology validation report.
1.0 Introduction	Req'd	Req'd	Describe the technology advance in sufficient detail so that a non specialist will understand (a) what it is and what is new about it, (b) principles of operation, (c) the specific performance advance beyond the current state-of-the-art (briefly describe the current state-of-the-art), (d) the rationale for flight validation in space to reduce risk to the first operational user, and (e) benefits to NASA Space Science and Earth Science Missions. For system technology validation missions, include items (a) – (e) above for the overall system and for each technology to be validated, describe how each technology contributes to the overall mission, and describe any interactions between the technologies.
2.0 Validation objective and Approach	Req'd	Req'd	State specifically the validation objective in terms of technology performance in the relevant space environment. Describe the measurements to be taken during both ground test and flight test to support this objective. Describe how this data will be correlated with technology performance models. Attention shall be given to descriptions of Technology Readiness Levels (TRLs). When the Technology Validation Plan is first required (at SRR) the technology has been demonstrated to be at TRL 4 or higher. Emphasis is placed on clear descriptions of TRLs 5 and 7. Detailed definitions of TRLs and relevant environments are found at the url listed in Section 5 of these Guidelines. For each technology, describe the measurements that allow the project-level success criteria to be verified. In addition, define the success criteria for each technology advance, and describe the plan to verify how these success criteria will be achieved .

5.0 Outlines for Technology Validation Plan and Technology Validation Report (cont'd)

Section	Technology Validation Plan	Technology Validation Report	Section Content
3.0 Testing 3.1 Ground test 3.2 Flight test	Req'd	Req'd	This section shall contain detailed descriptions of the required data and the associated ground and flight tests needed to acquire these data for validation of the technology advance. Where possible, list the expected values (or ranges of values) of parameters to be measured. Present the tests in a logical sequence of execution. Those tests/data used to justify achievement of TRLs 5, 6 and 7 with emphasis on TRLs 5 and 7, must be clearly identified and justified). Describe the ground tests and flight tests in separate sections. Clearly identify those instances where the results of ground test and flight test are to be compared. Test results, data analysis and correlation with performance models are discussed under Section 4.
4.0 Technology Validation Summary	N/A	Req'd	Summarize the results obtained during both ground test and flight test in this section of the Technology Validation Report. Document the test data in Appendix A of the Report. Using the full success criteria and relevant environments discussed under Section 2 above, discuss the specific results used to justify achievement of TRLs 5 and 7. Also, discuss the comparison of results from ground and flight tests. Correlate the test results with performance prediction models. Identify and discuss in detail anomalies and surprises if these occurrences lead to alterations in the performance models. Discuss achievement of success or partial success. Clearly document the range of operating conditions over which the performance models can be expected to provide valid predictions for this technology.
5.0 Technology infusion	Req'd	Req'd	The Technology Validation Report and Presentation at the Project Technology Validation Symposium are considered part of technology infusion. Provide in the Technology Validation Plan a schedule that shows the activities for preparation of the Technology Validation Report and for the presentation of results at the Technology Validation Symposium. If applicable, describe future strategies for incorporating this technology into other NASA as well as non-NASA programs. In addition, prepare a technology summary for the NASA Advanced Technology and Missions Studies (AT&MS) Database. The NMP Office will provide the forms for this short summary.
References	Optional	Req'd	
Appendices	N/A	Req'd	Appendix A should contain the experimental results from both ground and flight tests. Technology suppliers may wish to include additional appendices if this additional information will clarify or support the discussions in previous sections .

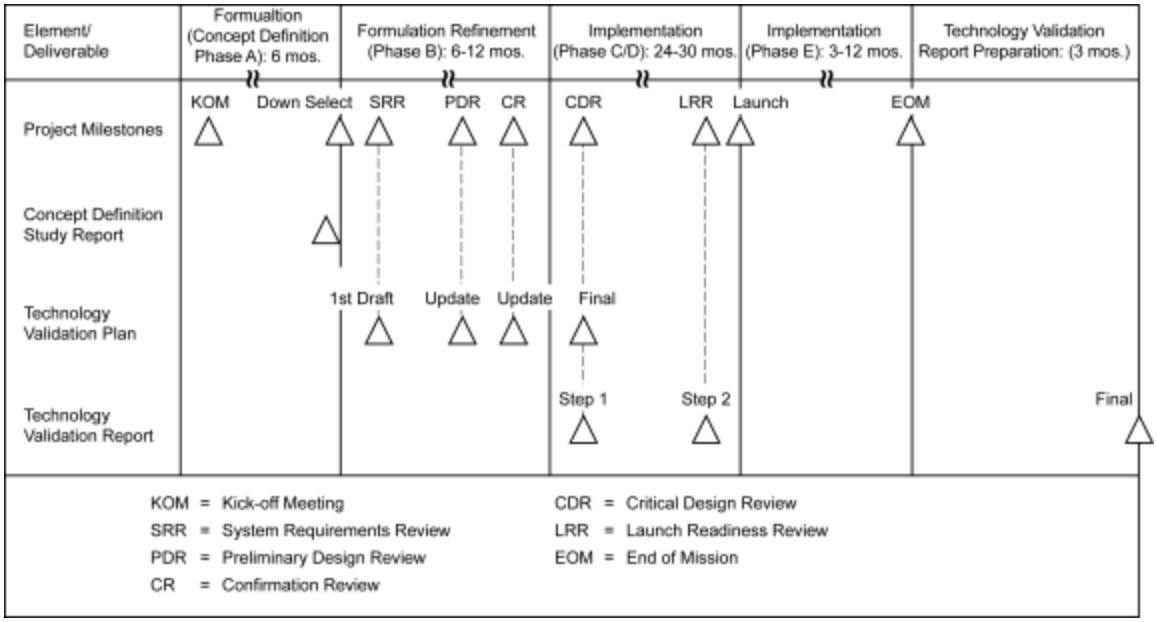


Figure 1. Typical New Millennium Project Milestones and Time Phasing of Deliverables for Technology Validation Plan and Technology Validation Report.